IPmux-16

TDMoIP Gateway

RAD

TDMoIP Driven™

FEATURES

- Carrier class, NEBS-compliant, modular TDMoIP gateway
- Extends up to sixteen E1/T1 or two E3/T3 circuits over IP and Ethernet networks
- Fully supports TDM-based services by maintaining synchronization over any packet-switched network (Ethernet, IP, or MPLS)
- Simple transport solution for voice, video, and data over IP
- Point-to-point and point-to-multipoint applications
- Transparent to protocols and signaling that run over E1/T1/E3/T3

- E1/T1 frames or DS0 bundles are transported over the network based on IP addressing
- Integrated DS0 level grooming and cross-connect between E1 or T1 ports
- Single or dual 10/100BaseT or 100BaseFx uplink to the network, with redundancy support on the Ethernet link level
- QoS support:
  - Labeling IP level priority Type of Service (ToS)
  - VLAN tagging and priority labeling according to IEEE 802.1 p&Q
- Low processing delay (under 2 msec)
- Compensates for packet network delay variation
- Redundant, hot-swappable power supplies

- Manageable interfaces: SNMP, Telnet and TFTP and XMODEM, with enhanced management tools and features
- Provisioning and monitoring of TDMoIP services is easily performed by the RADview Service Center application
- Compact platform, 1.5U high, 19-inch rack compatible enclosure

DESCRIPTION

- IPmux-16 provides a compact, simple to configure, easily scalable solution for transporting TDM E1/T1 and E3/T3 services over IP and Ethernet-based networks.
- IPmux-16 is suitable to be located at a central site or POP, aggregating TDMoIP traffic from multiple sources.

TDMoIP Gateway

- IPmux-16 takes data streams from up to sixteen E1/T1 or up to two E3/T3 ports and converts them into packets for transmission over the network (see *Table 1*). The addressing scheme of these packets is IP. The frames are transmitted via the Ethernet modules to the network. A second TDMoIP gateway at the remote location converts the IP packets back to TDM traffic.

- The primary benefit of IPmux-16 is to allow transparent E1/T1 and E3/T3 connectivity over Layer 2/3 packet networks, both in carrier and enterprise environments

- IPmux-16 is a standard IP device, supporting ICMP (ping), ARP, next hop and default gateway capabilities.

- IPmux-16 complies with the TDMoIP protocol, working in conjunction with IPmux-1, IPmux-1E, IPmux-8, Megaplex-ML-IP, Kilomux KML.11, and other third-party products that implement the TDMoIP protocol.

- IPmux-16 features a dry contact alarm port that can serve as a general-purpose input port. The alarms are classified into three categories, stored in the event log, and can generate a system trap that is sent to the NMS.

PERFORMANCE

- IPmux-16 can achieve end-to-end processing delay as low as 1.7 msec, using high-performance buffering and forwarding techniques.

- IP packet size is configurable. Greater packet length results in greater processing delay, yet a smaller bandwidth overhead.

- An enhanced buffering mechanism compensates for packet delay variation (jitter) of up to 32 msec for E1, 24 msec for T1, and 20 msec for E3/T3.

QOS SUPPORT

- IPmux-16 supports VLAN tagging and priority labeling according to 802.1 p&Q.

- User traffic VLAN-based separation is supported by applying a dedicated VLAN tag to every TDMoIP circuit, and a dedicated VLAN for managing the device.

- Type of Service (ToS) of the outgoing IP frames is user-configurable. This allows an en-route Layer-3 router or switch, which supports ToS (or Diffserv), to give higher priority to IPmux-16 traffic for delay-sensitive applications.
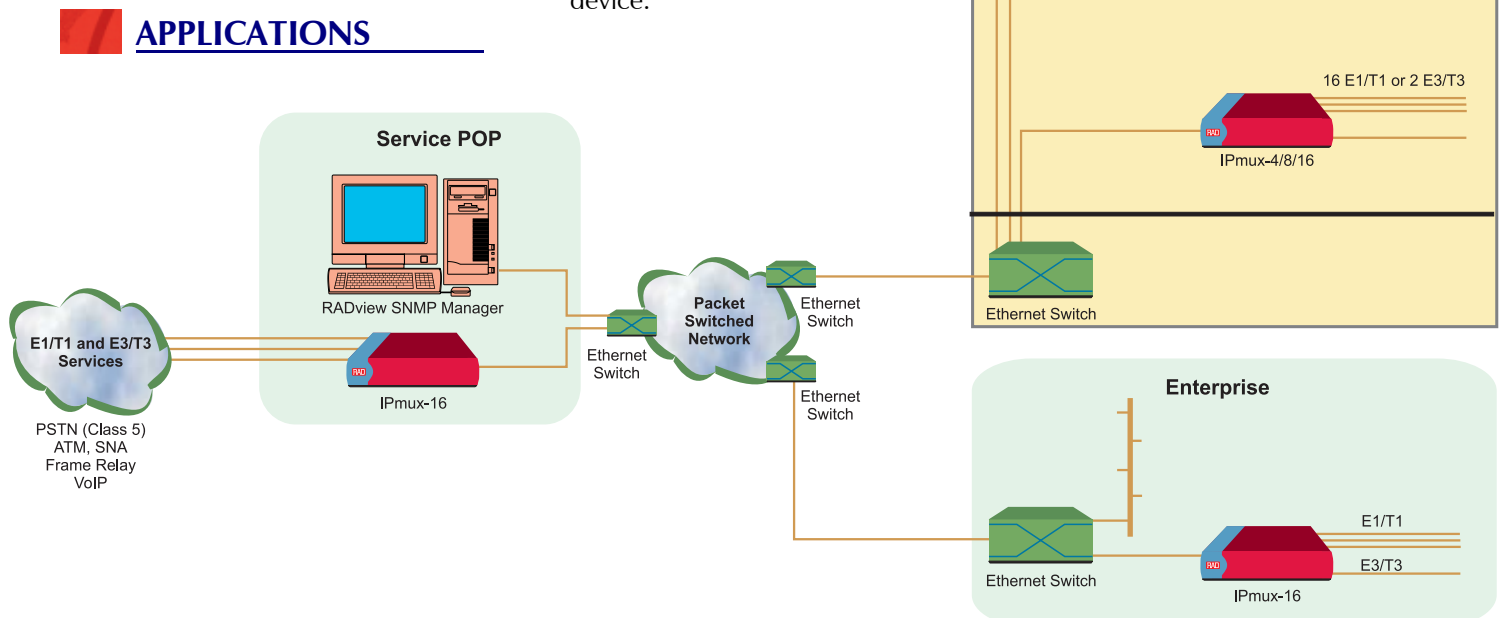
APPLICATIONS

Figure 1. Extending E1/T1 or E3/T3-based Services over IP

- Assigned, IANA-registered UDP socket number for TDMoIP simplifies flow classification through switches and routers.

OPERATION MODES

- Two types of service are offered:
  - **Unframed**: Full E1/T1 or E3/T3 circuits are transparently extended across the IP network, regardless of framing structure.
  - **Structured**: IPmux-16 can be configured on a per timeslot basis for fractional E1/T1 services over IP networks. CAS signaling is supported.
- Multibundling (grouping timeslots originating from a specific E1 or T1 port) can be performed for up to 31 bundles per E1 port and 24 bundles per T1 port for transport over the network. Both mesh and star topologies are supported.
- IPmux-16 allows internal cross-connect of bundles between its E1 or T1 ports.

TIMING

- IPmux-16 maintains synchronization between TDM devices by deploying advanced clock distribution mechanisms. The clocking options are:
  - **Internal**: The IPmux-16 clock's internal oscillator provides the master clock source for the TDM circuit.
  - **Loopback**: The transmit clock is derived from the respective port's receive clock.

- **Adaptive**: The clock is recovered from the Ethernet network interface.
- **External**: The station clock port is available and may be used to synchronize E1/T1 interfaces.

ETHERNET MODULE

- Two Ethernet modules can be installed in the IPmux-16 chassis, providing the uplink to the packet network.
- Each module supports a single 10/100BaseT or 100BaseFx port.
- IPmux-M/ETH/UTP, IPmux-M/ETH/MM-LC, and IPmux-M/ETH/SM-LC support re-ordering when packets arrive from the network in the wrong order, without considering them as lost packets.
- Ethernet link redundancy to the network is supported when IPmux-16 is equipped with two Ethernet modules (see *Figure 5*).

E1 AND T1 MODULES

- Each E1 or T1 module provides either four or eight standard E1 or T1 interfaces, which enable connectivity to any standard E1 or T1 device (see *Ordering*).
  - Integral LTU/CSU can be enabled for line protection and long haul applications.
  - Alarm detection and insertion are supported together with error statistics. SES/UAS statistics, LOS/AIS physical layer alarms and remote loop/local loop test modes are all supported. Standard E1/T1 alarms are supported end-to-end.

E3 AND T3 MODULES

- Each E3 or T3 module provides a single, standard E3 or T3 interface.
- Alarm detection and insertion are supported together with error statistics. SES/UAS statistics, LOS/AIS physical layer alarms and remote loop/local loop test modes are all supported. Standard E3 or T3 alarms are supported end-to-end.

POWER SUPPLY

- The IPmux-16 modular power supply supports carrier environments. The maximum power supplied by one unit is 75W with maximum power consumption of 57W.
- IPmux-16 features hot-swappable power supplies, enabling service to a power supply (see *Figure 4* and *Figure 5*).

DIAGNOSTICS & MANAGEMENT

- IPmux-16 supports remote loop and local loop testing. End-to-end alarm generation and end-to-end AIS indication are also provided. In the event that a local E1/T1 port receives AIS, it is passed to the remote port via the Ethernet/IP network. If a local Ethernet port is not connected, an AIS indication will be generated both in the local and the remote devices.
- On the E1/T1 or E3/T3 ports, SES and UAS statistics are collected in 15-minute intervals and are stored for 24 hours (96 intervals). E1/T1 physical layer alarms (LOS, AIS, LOF, LCV) are also supported.
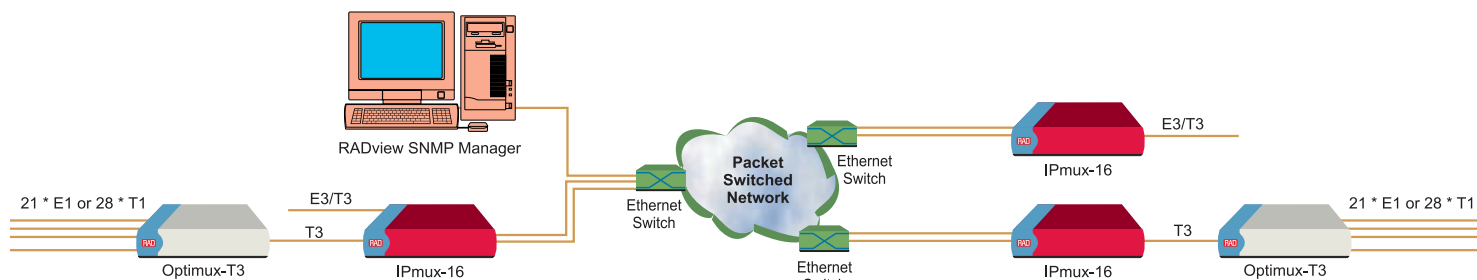

Figure 2. Extending E3/T3 Circuits over IP/Ethernet

- IPmux-16 features a dry contact alarm port (with a DB-9 connector), which allows the device to send/receive alarms by opening/closing the contact between the connector's pins.

- IPmux-16 monitors LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter). The events are stored in log files and SNMP traps are generated.

- IPmux-16 performs an internal built-in test (BIT) after power-up. The results of the test are visible via the local terminal.

- Software download is supported via the local terminal using XMODEM, or remotely, using TFTP. After downloading a new version of software, IPmux-16 automatically saves the previous version in non-volatile memory for backup purposes. Similarly, copies of the configuration file may be downloaded/uploaded to a remote workstation for backup and restore purposes.

- IPmux-16 can be configured and monitored:
  - Locally, via an ASCII terminal or over the local management port
  - Remotely via Telnet or SNMP (RADview Service Center TDMoIP)

- The RADview Service Center package enables provisioning TDMoIP service and managing the TDMoIP gateways by providing a user-friendly graphical display that allows monitoring and configuring of multiple IPmux devices. Fault isolation, statistics and events gathering are available. The Service Center's intuitive GUI interface, "point-and-click" functionality and easy-to-follow wizards increase the efficiency and accuracy of the service provisioning process.

SPECIFICATIONS

ETHERNET INTERFACE

- **Ports**
  1 per module

- **Standards**
  IEEE 802.3, 802.3u, 802.1 p&Q

- **Data Rate**
  10 or 100 Mbps, full-duplex

- **Range**
  Up to 100m/328 ft on UTP Category 5

- **Connector**
  RJ-45, 8-pin

- **Fiber Options**
  - **Range**
    See *Table 2*
  - **Connector**
    LC

MANAGEMENT ETHERNET INTERFACE

- **Ports**
  1

- **Standards**
  IEEE 802.3, 802.34 Ethernet

- **Date Rate**
  10 Mbps full/half-duplex

- **Connector**
  RJ-45, 8-pin

- **Range**
  Up to 100m over UTP Category 5 cables

E1 INTERFACE

- **Ports**
  4 or 8 ports per module
  (see *Ordering*)

- **Standards**
  ITU-T Rec. G.703, G.704, G.706, G.732, G.823

- **Framing**
  Unframed, CRC4 MF, CAS MF

- **Data Rate**
  2.048 Mbps

- **Line Code**
  HDB3

- **Receive Level**
  0 to -32 dB with LTU
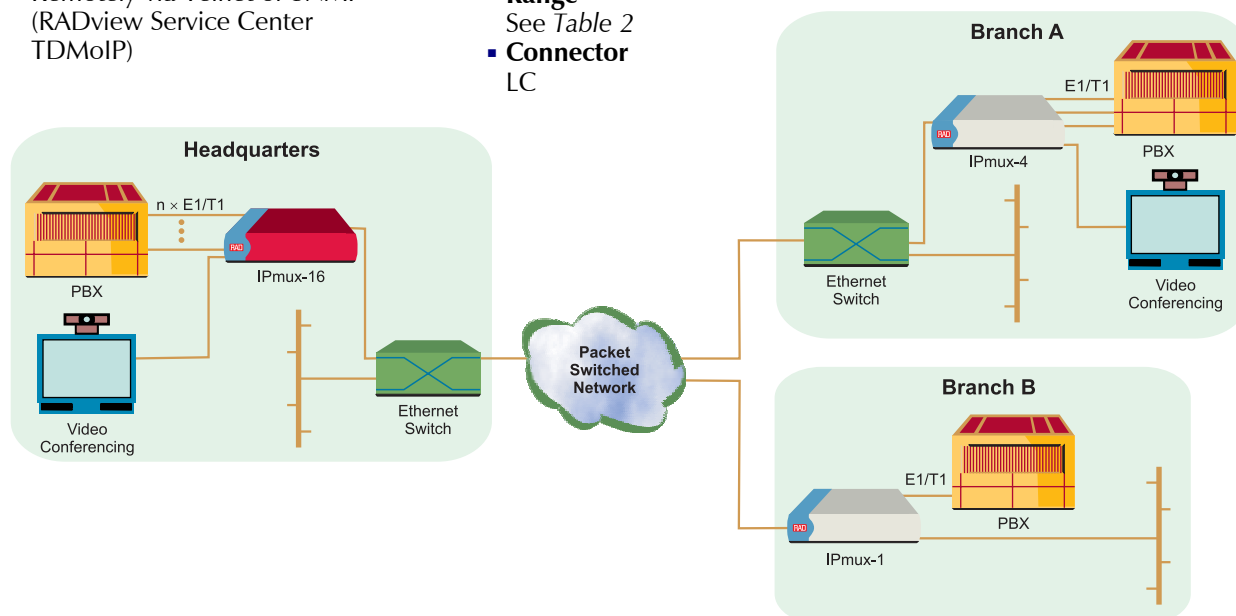 0 to -10 dB without LTU

Figure 3. Enterprise Connectivity over Campus or Metro Area Networks

- **Transmit Level**
  Balanced: ±3V ±10%
  Unbalanced: ±2.3V ±10%

- **Connector**
  Balanced: RJ-45, 8-pin
  Unbalanced: RJ-45, 75Ω (adapter cables from RJ-45 to BNC are supplied)

- **Line Impedance**
  Balanced: 120Ω
  Unbalanced: 75Ω

- **Jitter Performance**
  Per ITU-T G.823

T1 INTERFACE

- **Ports**
  4 or 8 ports per module
  (see *Ordering*)

- **Standards**
  AT&T TR-62411,
  ITU-T Rec. G.703, G.704,
  ANSI T1.403

- **Data Rate**
  1.544 Mbps

- **Line Code**
  AMI, B8ZS, B7ZS

- **Framing**
  Unframed, SF, ESF

- **Receive Level**
  0 to -30 dB

- **Transmit Level**
  ±2.7V ±10% at 0 to 655 ft
  with DSU
  0 dB, -7.5 dB, -15 dB, -22.5 dB
  with CSU

- **Connector**
  RJ-45, 8-pin

- **Line Impedance**
  100Ω, balanced

- **Jitter Performance**
  Per AT&T TR-62411

E3 INTERFACE

- **Data Rate**
  34.368 Mbps

- **Line Code**
  HDB3

- **Line Impedance**
  Unbalanced 75Ω

- **Standards**
  - Signal level:
    Receive and transmit levels according to G.703 standard
  - Jitter performance according to G.823 standard

- **E3 Framing**
  Unframed

T3 INTERFACE

- **Data Rate**
  44.736 Mbps

- **Line Code**
  B3ZS

Table 1. IPmux-16 Module Configuration

Requirement	TDM Modules	Ethernet Modules	Power Supply
4 E1	IPMUX-M/E1/4	IPMUX-M/ETH	One or two power supply modules can be ordered (the second module to provide backup).
4 T1	IPMUX-M/T1/4	IPMUX-M/ETH	
8 E1	2 x IPMUX-M/E1/4 or IPMUX-M/E1/8	IPMUX-M/ETH	
8 T1	2 x IPMUX-M/T1/4 or IPMUX-M/T1/8	IPMUX-M/ETH	
12E1	IPMUX-M/E1/4 + IPMUX-M/E1/8	IPMUX-M/ETH	
12 T1	IPMUX-M/T1/4 + IPMUX-M/T1/8	IPMUX-M/ETH	
16 E1	2 x IPMUX-M/E1/8	IPMUX-M/ETH	
16 T1	2 x IPMUX-M/T1/8	IPMUX-M/ETH	
1/2 E3	1 or 2 x IPMUX-M/E3	1 or 2 IPMUX-M/ETH	
1/2 T3	1 or 2 x IPMUX-M/T3	1 or 2 IPMUX-M/ETH	

Table 2. Fiber Options

Type	Connector	Optical Power		Receive Sensitivity		Loss (db/km)		Typical Range (km)
		Min	Max	Min	Max	Min	Max	
Multimode	LC	-19	-14	-32	-8	1	4	2
Single mode	LC	-15	-8	-28	-8	0.5	0.8	15

TDMoIP Gateway

- **Line Impedance**
  Unbalanced 75Ω

- **Standards**
  - Signal level:
    Receive and transmit levels according to ANSI T1.102 and Bellcore TR-NWT-000499
  - Jitter performance
    Bellcore TR-NWT-000499

- **T3 Framing**
  Unframed

DTE CONTROL INTERFACE

- **Standards**
  RS-232/V.24 (DTE)

- **Data Rate**
  9.6, 19.2, 38.4 57.6, or 115.2 kbps

- **Connector**
  DB-9

GENERAL

- **Power**
  Maximum power supplied by one unit is 75W with maximum power consumption of 57W

Note: Supports hot-swappable power supply redundancy

- **Physical**
  Height   7.6 cm/3.0 in (1.5U)
  Width   43.2 cm/17.0 in
  Depth   34.3 cm/13.5 in
  Weight 5.9 kg /13 lb (dependent on interface module)

- **Environment**
  Operating Temperature:
          0 to 50°C/32 to 122°F
  Storage Temperature:
          -20 to 70°C/32 to 110°F
  Humidity: up to 90%,
          non-condensing

ORDERING

BASIC UNIT

IPMUX-16/#/&/*
TDMoIP gateway

Specify station External clock port:
E1 for 2.048 Mbps clock input
T1 for 1.544 Mbps clock input
(optional, default is none)

& Specify power supply:
AC for 100 to 240 VAC
48 for -40 to -72 VDC

* Specify **R** for redundant identical power supply

INTERFACE MODULES

Note: At least one E1/T1 module and one Ethernet module must be ordered in conjunction with the IPmux-16 basic unit).

IPMUX-M/#/&
IPmux-16 E1/T1 port modules

Specify supported service:
E1CX for unbalanced E1 interface, with RJ-45 connectors (75Ω)
E1 for E1 interface, with RJ-45 connector
T1 for T1 interface, with RJ-45 connector
E3 for E3 interface, with BNC connector
T3 for T3 interface, with BNC connector

& Specify number of ports:
4 for 4 ports
8 for 8 ports

IPMUX-M/ETH/*
Ethernet network module, packet re-order support, RJ-45 connector

Specify Ethernet module:
UTP for for 10/100BaseT module, packet re-order support, RJ-45 connector
MM-LC for 100BaseFx multimode module with fiber LC connector, packet re-order support, RJ-45 connector
SM-LC for 100BaseFx single mode module with fiber LC connector, packet re-order support, RJ-45 connector

RM-27
Hardware for mounting IPmux-16 units in a 19-inch rack

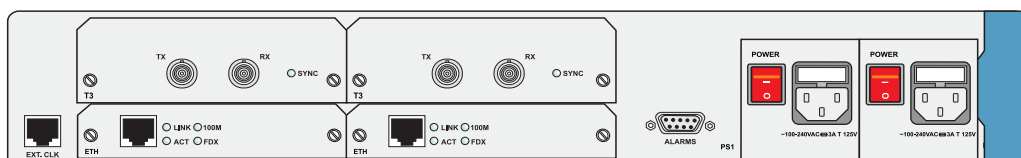**Figure 4. IPmux-16 Rear Panel (16 T1, Ethernet, Redundant Power Supply Options)**

Figure 5. IPmux-16 Rear Panel (2 T3 Option and 2 Ethernet Ports)